period when the mammoth existed, a molar of that animal having been dredged at a depth of five or six fathoms, and having been apparently derived from the Forest-bed.

The submerged forest rests upon a considerable thickness of clay, evidently the soil in which the trees grew. The clay rests upon Trias, a breccia of Devonian fragments intervening in places. This breccia appears to be of glacial age.

The gales of the winter of 1883–84 caused the exposure of considerable areas of the clay between tide-marks; and in one place, resting upon the breccia, two aggregations of rolled trap pebbles were found. These pebbles were shown to have probably served as smelting-hearths. In their neighbourhood an ingot of copper, a fragment of a second, some tin slag, a piece of glass, flint implements, and other articles were found, together with remains of piles driven into the ground. These traces of human work apparently belong to the bronze age. In Goodrington Bay pewter vessels, apparently of Roman date, were found by the writer's son in a bed 10 feet below high-tide mark, or at a lower level than that of the bronze-age relics.

After referring to the occurrence of some estuarine shells (*Scrobicularia*, *Hydrobia*, *Littorina*, and *Melampus*) in the clay near Redcliffe Towers, at the level where similar mollusca now exist (an occurrence which may, however, be due to a recent mixing of deposits), the author pointed out that as the coast is known to have undergone no change of level for nearly 2000 years, it is unlikely that it can have been raised 40 feet, and again depressed to the same extent, since the beginning of the bronze period, not more than about fifteen centuries earlier. It is more probable that the clay bed was deposited in a shallow mere or marsh, of land-water kept back by the sea-beach, which was then some hundreds of feet further to seaward, and that the forest, which consisted chiefly of willows, grew on the marsh. The mammoth tooth may have been derived from an older deposit, all other remains of mammalia obtained from the Forest-bed belonging to animals still existing.

MISCELLANEOUS.

Contributions to the Biology of Spiders.

By Dr. Friedrich Dahl.

In the first part of the next (ninth) volume of the 'Vierteljahrsschrift für wissenschaftliche Philosophie' an attempted representation of the psychical processes in spiders will be published by me. As certain points in the work may also be interesting to zoologists, I venture here to communicate very briefly the chief results of my investigations, referring to the above-mentioned memoir for further details and proofs. In that memoir I have first of all treated of the sensorial perceptions and then passed to the higher mental life.

The sense of sight is imperfect in spiders because all accommodation seems to be deficient. At a short distance *Attus arcuatus*, Bl., regards a ball of paper borne on a fine wire, or in fact anything that moves, as a fly. At a distance of about 1–2 centim., on the contrary, it is quite able to distinguish a fly from a bee of the same size. The geometrical spiders, in consequence of this short-sightedness, are almost exclusively dependent on the sense of touch, which certainly is developed in an astonishing manner.

Meta segmentata, Bl., *Zilla x-notata*, &c., not only feel that an object has got into their net, but they can even feel upon which radius it is, when they pull upon this radius from the centre. If they have captured a fly, and a second gets into the net at the moment, they must go to the central point or to the radius to which the new fly is suspended in order to find it, even though it may be in their immediate vicinity.

The senses of smell and hearing are also well developed. I have to add to my previous statements * that *Epëira patagiata*, Bl., for example, can even distinguish different odours. Thus the smell of oil of turpentine is much more disagreeable to it than that of ammonia.

Among instinctive proceedings I have especially observed the manufacture of the geometrical web more particularly. First the outer framework is spun; then, alternately from different sides, the rays, and simultaneously with these the round shelter in the middle; then a spiral extending nearly to the outer margin, which gives the whole firmness, and serves as a bridge during the further work; and finally a spiral thread, set with little drops, from the outer framework nearly to the middle shelter. During the making of the last-mentioned portion the dry spiral is for the most part destroyed. Some geometrical spiders, as is well known, complete their web and then lie in wait for prey upon the central shelter, sitting with the head downwards. (The webs are more or less vertical, because otherwise an insect would too easily drop out of them.) Others keep, at least in the daytime, in a dwelling placed near the web, connected by a signal-thread with the central shelter of the web; and others leave one sector unwoven for the signal-thread. Among the latter is *Zilla x-notata*, Bl., which I particularly made use of for my observations. It is remarkable that the first web that a young spider of this species prepares is always perfectly geometrical, and that its dwelling-place at first is the central shelter. The second web in rare instances already shows the defective sector. Generally, however, this form first appears after the preparation of *several* complete geometrical webs, although, as a rule, before the first change of skin. Sometimes we find as an intermediate step a complete geometrical web with a dwelling beside it. The transition to the second form is, however, very rarely quite smooth. It can, however, by no means be dependent upon external conditions or upon changes of the organs. We have before us here, therefore,

* Zool. Anz. 1883, p. 267, and Arch. f. mier. Anat. Bd. xxiv. p. 1 (Ann. Mag. Nat. Hist. Nov. 1884, p. 329).

a passage through earlier stages of the development of instinct, such as has long been known in the development of organs.

It has often been asserted that the geometrical spiders do not repair old webs. This, however, is true only in a limited sense. The outer framework and some of the radii which have already become nearly free from transverse threads are probably always used again by *Zilla x-notata* and others. The rest is gathered up, worked into a ball with the mouth, and thrown away. If the spider removes a lifeless object from the web, and damages the latter in so doing, it certainly sometimes reproduces the destroyed portion of the framework, the radii, and the central shelter. If we interrupt a spider in the formation of its web, by tearing away a portion of it with the corresponding part of the outer framework, all will be completed up to the part that has remained uninjured. In this case the completion of the framework is especially interesting, as this unaccustomed work is not usually successfully performed at once. Here we see very distinctly how reflection comes into play. I was still better able to ascertain reflection, or, what is the same thing, actual inference, in the case of *Attus arcuatus*, Bl., when I offered it flies touched with oil of turpentine. Sometimes the spider despised the species of fly employed (*Homalomyia canicularis*, L.), whilst it attacked other insects (e. g. *Chironomus tendens*, Fab.) just as before. This spider also draws similar conclusions in those cases in which it cannot overcome insects in consequence of their chitinous armour being too hard. These it usually attacks only once, and is then for a long time forewarned. Dangerous insects, however, such as small bees, it avoids, without having seen their sting. Here therefore we have an instinctive dread. Bee-like flies are equally dreaded.

I have also attempted to give a new explanation of the secondary sexual differences of many spiders, which are to be ascribed to changes by means of sexual selection.—*Zool. Anz.* no. 180, p. 591.

On the Classificatory Position of Hemiaster elongatus.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—You were good enough to admit a reply on the part of Mr. Percy Sladen and myself to a criticism of Prof. Sven Lovén, upon the classificatory position of *Hemiaster elongatus*, nobis, in your number for October last. I have received, in consequence, a very cordial reply from the Professor, in which he acknowledges that the form is not a species of *Palæostoma*, and points out how these latter forms of *Hemiaster* depart from the Mesozoic types of Desor, Wright, and Cotteau, in the extension of the madreporite and in the diminution in the number of the ovarial pores. He suggests that we should place our species in a new genus. The consideration of this proposed splitting up of the genus *Hemiaster* we must defer for a while, for it is a matter that concerns M. de Loriol also; and, moreover, we can hardly determine the propriety of the step until we have completed our description of the Echinoidea of the Tertiaries of Sind.

Yours &c.,

Dec. 1, 1884. P. Martin Duncan.